CLAIMS:

We Claim:

1. A vehicle including a system for determining the occupancy state of a seat in the vehicle, the system comprising:

a plurality of transducers arranged in the vehicle, each of said transducers providing data relating to the occupancy state of the seat; and

processor means coupled to said transducers for receiving the data from said transducers and processing the data to obtain an output indicative of the current occupancy state of the seat, said processor means comprising an algorithm created from a plurality of data sets, each of said data sets representing a different occupancy state of the seat and being formed from data from said transducers while the seat is in that occupancy state,

said algorithm producing the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from said transducers.

2. The vehicle of claim 1, wherein said algorithm is a pattern recognition algorithm.

3. The vehicle of claim 1, wherein said processor means are arranged to accept only a separate stream of data from each of said transducers such that the stream of data from each of said transducers is passed to said processor means without combining with another stream of data.

4. The vehicle of claim 3, wherein said processor means are arranged to process each of said separate streams of data independent of the processing of the other streams of data.

3 5. The vehicle of claim 1, wherein one of said transducers is a reclining angle detecting sensor for detecting a tilt angle of the seat between a back portion of the seat and a seat portion of the seat.

4~~8~~. The vehicle of claim 1, wherein one of said transducers is a seat position sensor for detecting the position of the seat relative to a fixed reference point in the vehicle.

5~~7~~. The vehicle of claim 1, wherein one of said transducers is a heartbeat sensor for sensing a heartbeat of an occupying item of the seat.

6~~8~~. The vehicle of claim 1, wherein said transducers include a plurality of weight sensors, each of said weight sensors measuring the weight applied onto the seat at a different location.

7~~9~~. The vehicle of claim 1, wherein said transducers include a weight sensor arranged to measure the weight applied to a surface of a seat portion of the seat.

8~~10~~. The vehicle of claim 1, wherein said transducers include a force, pressure or strain gage arranged to measure the weight applied to the entire seat.

9~~11~~. The vehicle of claim ~~10~~ 8, wherein the seat includes a support structure for supporting the seat above a floor of a passenger compartment of the vehicle, said force, pressure or strain gage being attached to the support structure.

10~~12~~. The vehicle of claim 1, wherein said transducers include a plurality of electromagnetic wave sensors capable of receiving waves at least from a space above the seat, each of said electromagnetic wave sensors being arranged at a different location.

11~~13~~. The vehicle of claim 1, wherein said transducers include at least two ultrasonic sensors capable of receiving waves at least from a space above the seat, each of said ultrasonic sensors being arranged at a different location.

12~~14~~. The vehicle of claim ~~13~~ 11, wherein a first one of said two ultrasonic sensors is arranged on or adjacent to a ceiling of the vehicle and a second one of said two ultrasonic sensors

is arranged at a different location in the vehicle such that an axis connecting said first and second ultrasonic sensors is substantially parallel to a second axis traversing a volume in the vehicle above the seat.

13~~15~~. The vehicle of claim 12~~14~~, wherein said second ultrasonic sensor is arranged on an instrument panel of the vehicle.

14~~16~~. The vehicle of claim 13~~13~~, wherein said transducers further include a third ultrasonic sensor arranged on an interior side surface of the passenger compartment.

15~~17~~. The vehicle of claim 14~~16~~, wherein said transducers further include a fourth ultrasonic sensor arranged on or adjacent an interior side surface of the passenger compartment.

16~~18~~. The vehicle of claim 11~~12~~, wherein said ultrasonic sensors are capable of transmitting waves at least into the space above the seat.

17~~19~~. The vehicle of claim 11~~13~~, wherein said ultrasonic sensors are aimed such that the ultrasonic fields generated thereby cover a substantial portion of the volume surrounding the seat.

18~~20~~. The vehicle of claim 11~~13~~, wherein the system further comprises horns for adjusting the transducer field angles of said ultrasonic sensors to reduce reflections off of fixed surfaces within the vehicle.

19~~21~~. The vehicle of claim 11~~13~~, wherein the system further comprises grills for adjusting the transducer field angles of said ultrasonic sensors.

20~~22~~. The vehicle of claim 1, wherein said transducers include four ultrasonic sensors capable of receiving waves at least from a space above the seat, said ultrasonic sensors being arranged at corners of an approximate rhombus which surrounds the seat.

21 ~~23~~. The vehicle of claim 1, wherein said transducers include a plurality of ultrasonic sensors capable of transmitting waves at least into a space above the seat and receiving waves at least from the space above the seat, each of said ultrasonic sensors being arranged at a different location, said ultrasonic sensors having different transmitting and receiving frequencies and being arranged in the vehicle such that sensors having adjacent transmitting and receiving frequencies are not within a direct ultrasonic field of each other.

24. The vehicle of claim 1, wherein the algorithm is a pattern recognition algorithm.

~~24~~ 25. The vehicle of claim 24, wherein the pattern recognition algorithm is a neural network or neural fuzzy algorithm.

23 ~~26~~. The vehicle of claim 1, wherein at least one of said transducers is a capacitive sensor.

24 ~~27~~. The vehicle of claim 1, wherein said transducers are selected from a group consisting of seat belt buckle sensors, seatbelt payout sensors, infrared sensors, inductive sensors and radar sensors.

25 ~~28~~. The vehicle of claim 1, further comprising control means coupled to said processor means for controlling a component or device in the vehicle in consideration of the output indicative of the current occupancy state of the seat obtained from said processor means.

26 ~~29~~. The vehicle of claim ~~28~~ 25, wherein the component or device is an airbag system including at least one deployable airbag and said control means control at least one parameter of the deployment of said at least one airbag including the inflation rate, the deflation rate, the incoming gas flow rate and the exiting gas flow rate.

27 ~~30~~. The vehicle of claim 1, wherein said transducers include sensors capable of receiving waves modified by passing through a space above the seat.

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31. A vehicle including a system for determining the occupancy state of a seat in a vehicle, the system comprising:

a plurality of transducers arranged in the vehicle, each of said transducers providing data relating to the occupancy state of the seat, and

processor means coupled to said transducers for receiving only a separate stream of data from each of said transducers such that the stream of data from each of said transducers is passed to said processor means without combining with another stream of data and processing the streams of data to obtain an output indicative of the current occupancy state of the seat, said processor means comprising an algorithm created from a plurality of data sets, each of said data sets representing a different occupancy state of the seat and being formed from separate streams of data, each only from one of said transducers, while the seat is in that occupancy state,

said algorithm producing the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from separate streams of data, each only from one of said transducers.

30. The vehicle of claim 29, wherein said processor means are arranged to process each of said separate streams of data independent of the processing of the other streams of data.

31. The vehicle of claim 29, wherein one of said transducers is a weight sensor arranged in the seat.

34. The vehicle of claim 31, wherein one of said transducers is a reclining angle detecting sensor for detecting a tilt angle of the seat between a back portion of the seat and a seat portion of the seat.

33. The vehicle of claim 29, wherein one of said transducers is a seat position sensor for detecting the position of the seat relative to a fixed reference point in the vehicle.

34 ~~36~~. The vehicle of claim ~~31~~ 29, wherein said transducers include a plurality of weight sensors, each of said weight sensors measuring the weight applied onto the seat at a different location.

35 ~~37~~. The vehicle of claim ~~31~~ 29, wherein said transducers include a weight sensor arranged to measure the weight applied to a surface of a seat portion of the seat.

36 ~~38~~. The vehicle of claim ~~31~~ 29, wherein said transducers include a force, pressure or strain gage arranged to measure the weight applied to the entire seat.

37 ~~39~~. The vehicle of claim ~~31~~ 29, wherein said transducers include a plurality of electromagnetic wave sensors capable of receiving waves at least from a space above the seat, each of said electromagnetic wave sensors being arranged at a different location.

38 ~~40~~. The vehicle of claim ~~31~~ 29, wherein said transducers include at least two ultrasonic sensors capable of receiving waves at least from a space above the seat, each of said ultrasonic sensors being arranged at a different location.

39 ~~41~~. The vehicle of claim ~~40~~ 38, wherein a first one of said two ultrasonic sensors is arranged on or adjacent to a ceiling of the vehicle and a second one of said two ultrasonic sensors is arranged at a different location in the vehicle such that an axis connecting said first and second ultrasonic sensors is substantially parallel to a second axis traversing a volume in the vehicle above the seat.

40 ~~42~~. The vehicle of claim ~~40~~ 38, wherein the system further comprises horns for adjusting the transducer field angles of said ultrasonic sensors to reduce reflections off of fixed surfaces within the vehicle.

41 ~~43~~. The vehicle of claim ~~31~~ 29, wherein said transducers include a plurality of ultrasonic sensors capable of transmitting waves at least into a space above the seat and receiving waves at

least from the space above the seat, each of said ultrasonic sensors being arranged at a different location, said ultrasonic sensors having different transmitting and receiving frequencies and being arranged in the vehicle such that sensors having adjacent transmitting and receiving frequencies are not within a direct ultrasonic field of each other.

42 44. The vehicle of claim 29, wherein at least one of said transducers is a capacitive sensor.

43 45. The vehicle of claim 29, wherein said transducers are selected from a group consisting of seat belt buckle sensors, seatbelt payout sensors, infrared sensors, inductive sensors and radar sensors.

44 46. The vehicle of claim 29, further comprising control means coupled to said processor means for controlling a component or device in the vehicle in consideration of the output indicative of the current occupancy state of the seat obtained from said processor means.

45 47. The vehicle of claim 44, wherein the component or device is an airbag system including at least one deployable airbag, said control means controlling at least one parameter of the deployment of said at least one airbag including the inflation rate, the deflation rate, the incoming gas flow rate and the exiting gas flow rate.

46 48. The vehicle of claim 29, wherein said transducers include sensors capable of receiving waves modified by passing through a space above the seat.

49. A vehicle including a system for determining the occupancy state of a seat in a vehicle, the system comprising:

a plurality of transducers including at least two wave-receiving transducers arranged in the vehicle, each of said transducers providing data relating to the occupancy state of the seat, a first one of said wave-receiving transducers being arranged on or adjacent to a ceiling of the vehicle and a second one of said wave-receiving transducers being arranged at a different location in the

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vehicle such that an axis connecting said first and second wave-receiving transducers is substantially parallel to a longitudinal axis of the vehicle, substantially parallel to a transverse axis of the vehicle or passes through a volume above the seat, and

a processor coupled to said transducers for receiving data from said transducers and processing the data to obtain an output indicative of the current occupancy state of the seat, said processor comprising an algorithm which produces the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from said transducers.

50. The vehicle of claim 49, wherein said algorithm is created from a plurality of data sets, each of said data sets representing a different occupancy state of the seat and being formed from data from said transducers while the seat is in that occupancy state.

51. The vehicle of claim 49, wherein said wave-receiving transducers are arranged to receive ultrasonic waves.

52. The vehicle of claim 49, wherein said processor means are arranged to accept only a separate stream of data from each of said transducers such that the stream of data from each of said transducers is passed to said processor means without combining with another stream of data, said processor means being further arranged to process each of said separate streams of data independent of the processing of the other streams of data.

53. The vehicle of claim 49, wherein said second wave-receiving transducer is arranged on an instrument panel of the vehicle.

54. The vehicle of claim 49, wherein said plurality of transducers further includes a third wave-receiving transducer arranged on an interior side surface of the passenger compartment.

55. The vehicle of claim 54, wherein said plurality of transducers further includes a fourth wave-receiving transducer arranged on or adjacent an interior side surface of the passenger compartment.

56. The vehicle of claim 49, wherein said wave-receiving transducers are capable of transmitting waves at least into the space above the seat.

57. The vehicle of claim 56, wherein said wave-receiving transducers are aimed such that the wave fields generated thereby cover a substantial portion of the volume surrounding the seat.

58. The vehicle of claim 49, wherein the system further comprises horns for adjusting the transducer field angles of said wave-receiving transducers to reduce reflections off of fixed surfaces within the vehicle.

59. The vehicle of claim 49, wherein the system further comprises grills for adjusting the transducer field angles of said wave-receiving transducers to reduce reflections off of fixed surfaces within the vehicle.

60. The vehicle of claim 49, wherein said plurality of transducers includes a weight sensor arranged in the seat.

61. The vehicle of claim 49, wherein said plurality of transducers includes a reclining angle detecting sensor for detecting a tilt angle of the seat between a back portion of the seat and a seat portion of the seat.

62. The vehicle of claim 49, wherein said plurality of transducers includes a seat position sensor for detecting the position of the seat relative to a fixed reference point in the vehicle.

63. The vehicle of claim 49, wherein said plurality of transducers includes a plurality of weight sensors, each of said weight sensors measuring the weight applied onto the seat at a different location.

64. The vehicle of claim 49, wherein said plurality of transducers includes a weight sensor arranged to measure the weight applied to a surface of a seat portion of the seat.

65. The vehicle of claim 49, wherein said plurality of transducers includes a force, pressure or strain gage arranged to measure the weight of the entire seat.

66. A vehicle including a system for determining the occupancy state of a seat in the vehicle, the system comprising:

a plurality of transducers arranged in the vehicle, each of said transducers providing data relating to the occupancy state of the seat, said plurality of transducers including a wave-receiving transducer and a non-wave-receiving transducer, and

processor means coupled to said transducers for receiving the data from said transducers and processing the data to obtain an output indicative of the current occupancy state of the seat, said processor means comprising an algorithm created from a plurality of data sets, each of said data sets representing a different occupancy state of the seat and being formed from data from said transducers while the seat is in that occupancy state,

said algorithm producing the output indicative of the current occupancy state of the seat upon inputting a data set representing the current occupancy state of the seat and being formed from data from said transducers.

67. The vehicle of claim 66, wherein said algorithm is a pattern recognition algorithm.

68. The vehicle of claim 66, wherein said processor means are arranged to accept only a separate stream of data from each of said transducers such that the stream of data from each of said transducers is passed to said processor means without combining with another stream of data.

69. The vehicle of claim 68, wherein said processor means are arranged to process each of said separate streams of data independent of the processing of the other streams of data.

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